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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte WANG YUEH, HUEY-CHIANG LIOU, HAI DENG, and
HOK-KIN CHOI

Appeal 2009-006467
Application 10/687,288
Technology Center 1700

Decided: March 12, 2010

Before LINDA M. GAUDETTE, KAREN M. HASTINGS, and
JEFFREY B. ROBERTSON, *Administrative Patent Judges*.

ROBERTSON, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellants appeal under 35 U.S.C. § 134(a) from the Examiner's final rejection of pending claims 21-35. (Appeal Brief filed March 21, 2008, hereinafter "App. Br.," 3; Final Rejection mailed June 28, 2007, hereinafter "Final"). We have jurisdiction pursuant to 35 U.S.C. § 6(b).

We REVERSE and ENTER A NEW GROUND OF REJECTION under 37 C.F.R. § 41.50(b).

STATEMENT OF THE CASE

Appellants describe a method of accomplishing photolithography that is said to result in substantially reduced line wide roughness (LWR). (Spec. [0024].) Claims 21 and 27, reproduced below, are representative of the subject matter on appeal.

21. A method comprising:
depositing a layer on a substrate;
depositing a non-chemically amplified photoresist layer upon the layer, the non-chemically amplified photoresist layer having a developer-soluble resin and a photoactive compound, the photoactive compound inhibiting solubility of the developer-soluble resin;
exposing selected portions of the non-chemically amplified photoresist layer to an extreme ultra-violet light source such that solubility of the selected portions of the non-chemically amplified photoresist layer is promoted; and
developing the exposed portions of the non-chemically amplified photoresist layer.

27. The method of claim 21, wherein the non-chemically amplified photoresist layer does not include a photo-acid generator (PAG).

(Claims App, pp. 15-16.)

THE REJECTIONS

The Examiner rejected claim 27 under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement.

The Examiner rejected claims 21-25 and 30-34 under 35 U.S.C. § 103(a) as being unpatentable over Takemura (U.S. 5,759,739 (issued June 2, 1998)) in view of Sun (US 2005/0074699 A1, (published Apr. 7, 2005)).

The Examiner rejected claims 21, 26, 30, and 35 under 35 U.S.C. § 103(a) as being unpatentable over Cathey (U.S. 5,358,599 issued Oct. 25, 1994) in view of Sun.

The Examiner rejected claims 27-29 under 35 U.S.C. § 103(a) as being unpatentable over Cathey in view of Sun, and further in view of Zhang (US 2004/0204328 A1, (published Oct. 14, 2004)) and Asakura (U.S. 6,261,738 B1, (issued Jul. 17, 2001)).

ISSUES

In rejecting claim 27, the Examiner found that the photoactive compound (PAC) is a photoacid generator (PAG), and therefore there is no disclosure in the Specification that the non-chemically amplified generator does not include a photoacid generator. (Examiner's Answer entered June 11, 2008, hereinafter "Ans.," 3.)

In rejecting the claims over the cited prior art, the Examiner found that both Takemura and Cathey fail to disclose that the photoresist layer is non-chemically amplified. (Ans. 4-6.) The Examiner found that Sun discloses that a chemically amplified photoresist layer can be replaced with a non-chemically amplified photoresist layer, which can then be used to perform photolithographic processes at wavelengths less than 365 nm including the extreme ultraviolet light recited in the claims. (Ans. 5 and 6.) The Examiner determined that it would have been obvious to replace the photoresist layers of Takemura or Cathey with the non-chemically amplified photoresist layers of Sun to perform photolithographic processes in a shorter wavelength range. (*Id.*)

Appellants contend that the Specification discloses that photoactive compounds are different than photoacid generators and the Specification discloses embodiments that exclude a photoacid generator. (App. Br. 8; Reply Brief filed August 6, 2009, (hereinafter "Rep. Br.") 2-3.)

Appellants argue that Sun does not disclose non-chemically amplified photoresists useful for extreme UV (EUV) lithography. (App. Br. 10.) In particular, Appellants argue that Sun's disclosure:

should not be construed to encompass the next-generation EUV lithography which uses a much smaller wavelength of about 13nm. Furthermore, materials suitable for DUV lithography commonly are not suitable for EUV lithography. Accordingly, the statement in Sun should not be construed to mean that non-chemically amplified photoresists in general are suitable for EUV.

(App. Br. 10.)

Appellants also argue that Takamura and Cathey cannot be combined with Sun because Sun is directed to non-chemically amplified photoresists and Takamura and Cathey are directed to chemically amplified photoresists. (App. Br. 11 and 12.)

The following dispositive issues arise from Appellants' contentions:

Have Appellants identified error in the Examiner's finding that the Specification does not adequately describe a "non-chemically amplified photoresist layer [that] does not include a photo-acid generator (PAG)" as recited in claim 27?

Have Appellants identified error in the Examiner's determination that Sun discloses non-chemically amplified photoresists for extreme UV lithography?

FINDINGS OF FACT

The record supports the following findings of fact (FF) by a preponderance of the evidence.

1. Appellants' Specification discloses that typical prior art non-chemically-amplified photoresists were found to be inadequate as photoresist technology moved toward smaller wavelengths, e.g. deep ultra-violet (DUV) with wavelengths of 248 nm or 193 nm, due to the inability of the photoresists to become more transparent in the DUV region. (Spec. [0003].)
2. Appellants' Specification states that chemically-amplified photoresists were developed to address the limitation of chemically amplified photoresists. (Spec. [0003].)
3. Appellants' Specification states "[f]or chemically amplified photoresists, the mechanism is different [than for non-chemically-amplified photoresists]. Instead of PAC, Photoacid generator (PAG) is used." (Spec. [0005].)
4. Appellants' Specification states "[e]mbodiments of the invention provide a non-chemically amplified photoresist (i.e., does not include PAG), which results in reduced LWR." (Spec. [0029].)
5. Appellants' Specification states "[f]or one embodiment the photoresist is applied in the EUV technology (e.g., wavelength is 13.4 nm)." (Spec. [0030].)
6. Takemura discloses a chemically amplified photoresist composition including three components; an alkali-soluble resin, a dissolution inhibitor, and a photoacid generator. (Col. 1, ll. 10-12; col. 2, ll. 29-32.)
7. Takemura discloses "[t]he resulting positive resist composition is highly sensitive to high energy radiation such as deep ultraviolet rays, electron rays, and X rays. . . ." (Col. 2, ll. 37-39.)

8. Cathey discloses a photoresist including a photosensitive resin and a photoacid generator, i.e., a chemically amplified photoresist. (Col. 4, ll. 30-44.)
9. Sun discloses: “due to the extraordinarily thin photoresist, this invention opens an opportunity to replace the ever troubling chemically amplified photoresist with non-chemically amplified photoresists for the photolithography process of KrF or shorter wavelengths.” (Para. [0039].)
10. Sun discloses a protective layer that possesses light absorbing properties at wavelengths of “less than about 500 nm (e.g. 436 nm, 365 nm, 248 nm, 193 nm, 157 nm, 13 nm, 11 nm, 4, nm, and X-ray).” (Para. [0016].)
11. Sun discloses an example with a commercially available non-chemically amplified photoresist that is exposed at a wavelength of 365 nm. (Para. [0050].)
12. Asakura discloses:

it becomes clear that chemical and thermal stability of a latent catalyst is vital for a chemically amplified resist and that latent acids which can work in a non-chemically amplified resist are not necessarily applicable to chemically amplified resists because of the different acid diffusion requirements, acid strength requirements and thermal and chemical stability requirements.

(Col. 19, ll. 37-43.)

PRINCIPLES OF LAW

To satisfy the written description requirement, a patent applicant must “convey with reasonable clarity to those skilled in the art that, as of the filing

date sought, he or she was in possession of the invention.” *Vas-Cath Inc. v. Mahurkar*, 935 F.2d 1555, 1563-64 (Fed. Cir. 1991) (emphasis omitted).

The Examiner bears the initial burden, on review of prior art or on any other ground, of presenting a prima facie case of unpatentability. *In re Oetiker*, 977 F.2d 1443, 1445 (Fed. Cir. 1992). “[R]ejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” *KSR Int’l. Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007), quoting *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006).

ANALYSIS

Written Description-Claim 27

We agree with Appellants that the Specification provides sufficient written descriptive support for the limitation “non-chemically amplified photoresist layer does not include a photo-acid generator (PAG).” Appellants’ Specification provides literal support for the recited limitation. (FF 4.) Moreover, Appellants’ Specification clearly distinguishes between chemically amplified photoresists employing a PAG and non-chemically amplified photoresists employing a PAC. (FF 1-3.) Therefore, the Examiner’s finding that PAG’s are a subset of PAC’s and thus may not be properly excluded from claim 27 is not adequately supported by the record. The Examiner has not provided sufficient basis that Appellants have failed to convey with reasonable clarity to one of skilled in the art that they were in possession of the subject matter of claim 27.

Prior Art Rejections

We are persuaded by Appellants' arguments that the combination of Takemura or Cathey with Sun fails to fairly suggest the recited method. Specifically, while Sun suggests that chemically amplified photoresists may be replaced with non-chemically amplified photoresists at KrF or shorter wavelengths, Sun only discloses commercial non-chemically amplified photoresists that are exposed at 365 nm, not in the EUV region. (FF 11.) Although Sun discloses protective layers with light absorbing properties in the EUV region (13nm), Sun does not specifically disclose non-chemically amplified photoresists exposed to such shorter wavelengths. (See FF 8-11.)

Appellants' arguments that materials for lithography performed at different UV wavelength ranges, such as DUV, are not necessarily suitable for EUV lithography are supported by Appellants' Specification as well as Asakura. Appellants' Specification discloses that conventional non-chemically amplified photoresists are not suitable for DUV lithography. (FF 1.) Moreover, Asakura discloses that latent acids generated from the PAG in chemically amplified resists are not necessarily applicable to non-chemically amplified photoresists. (FF 12.) Accordingly, the Examiner has not provided a sufficient basis that the materials for the chemically amplified photoresists disclosed in Takemura and Cathey would be suitable to function as non-chemically amplified photoresists in the EUV region. Therefore we cannot sustain the Examiner's rejections.

NEW GROUND OF REJECTION

The following new ground of rejection is entered pursuant to 37 C.F.R. § 41.50(b).

Claims 21-35 are rejected under 35 U.S.C. § 112, first paragraph, because the Specification, while being enabling for PAC's of the formula disclosed in Figure 4, does not reasonably provide enablement for the general recitation of "photoactive compound" recited in the claims. The Specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the invention commensurate in scope with these claims for the reasons explained below.

ADDITIONAL FINDINGS OF FACT

The record supports the following findings of fact (FF) by a preponderance of the evidence.

13. With respect to the photoactive compound, Appellants'

Specification states:

Figure 4 illustrates the synthesis of a PAC for use as a component of a photoresist in accordance with one embodiment of the invention. As shown in Figure 4, synthesis 400, produces PAC 410 that includes a ballast group. The ballast group, R, may be any cage phenyl, or phenyl-substituted group. The photo-speed, and developer solubility, can be modified, by varying the ballast group (e.g., between electron donating and electron withdrawing).

(Spec. [0022].)

14. Appellants' Figure 4 is reproduced below:

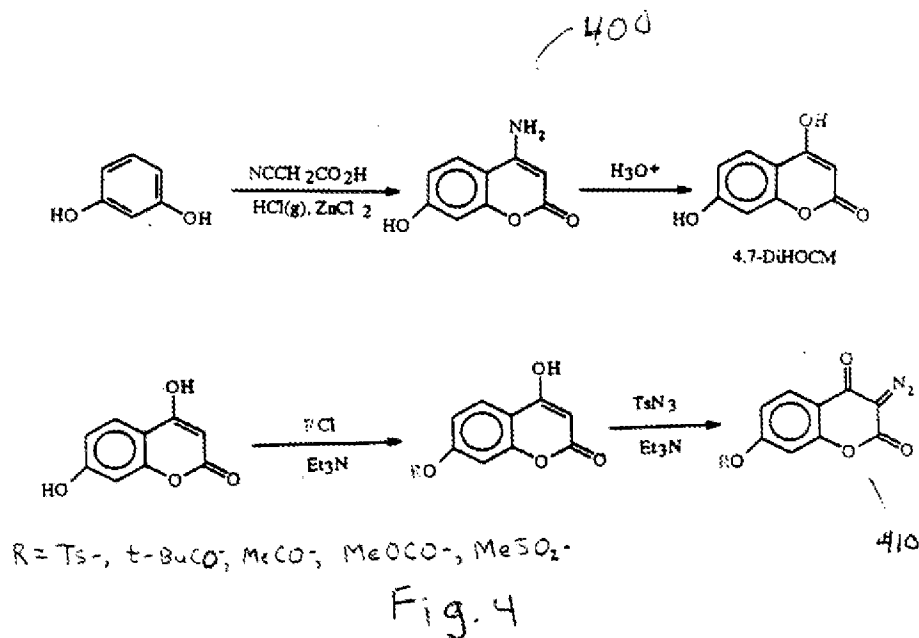


Figure 4 above depicts the synthesis 400 of a photoactive compound 410. (See FF 13.)

15. Appellants' Specification describes one example of the reaction of a photoactive compound upon exposure to a light source. (Spec. [023], Fig. 5.)
16. Appellants' Specification describes a general process for performing a method of depositing and developing a photoresist. (Spec. [0024]-[0028]; Fig. 6.)

PRINCIPLES OF LAW

“To satisfy the enablement requirement of § 112, ¶ 1, a patent application must adequately disclose the claimed invention so as to enable a person skilled in the art to practice the invention at the time the application was filed without undue experimentation.” *In re Swartz*, 232 F.3d 862, 863 (Fed. Cir. 2000) (citation omitted).

The scope of the claims must not be broader than the scope of the enabling description in the specification. *See Nat'l Recovery Tech., Inc. v. Magnetic Separation Systems, Inc.*, 166 F.3d 1190, 1196 (Fed. Cir. 1999). “The scope of enablement, in turn, is that which is disclosed in the specification plus the scope of what would be known to one of ordinary skill in the art without undue experimentation.” *Id.* (citation omitted).

To determine whether the necessary experimentation is undue, we look at factors including “(1) the quantity of experimentation necessary, (2) the amount of direction or guidance presented, (3) the presence or absence of working examples, (4) the nature of the invention, (5) the state of the prior art, (6) the relative skill of those in the art, (7) the predictability or unpredictability of the art, and (8) the breadth of the claims.” *In re Wands*, 858 F.2d 731, 737 (Fed. Cir. 1988).

Arts based on chemical reactions may be unpredictable. *In re Fisher*, 427 F.2d 833, 839 (C.C.P.A. 1970). “In cases involving unpredictable factors, such as most chemical reactions and physiological activity, the scope of enablement obviously varies inversely with the degree of unpredictability of the factors involved.” *Id.*

ANALYSIS

Independent claims 21 and 30 generally recite a “photoactive compound” which promotes the solubility of a selected portion of a non-chemically amplified photoresist exposed to an extreme ultra-violet light source. Thus, the claims with respect to the photoactive compound are broad. However, Appellants’ only description with respect to the photoactive compound is in conjunction with the synthesis of the particular

limited genus of photoactive compounds depicted in Figure 4. (FF 13, 14.) While the Specification describes varying the R group on the depicted photoactive compound (FF 13), Appellants provide no other guidance as to what compounds, other than those having the chemical structure depicted in Figure 4, would be useful in the claimed invention.

In addition, the Specification only provides one example showing exposure of the PAC compound to a light source. (FF 15.) As pointed out by Appellants, the materials suitable for DUV lithography commonly are not suited for EUV lithography. (App. Br. 10.) Moreover, Asakura discloses that photoactive compounds, which can work in a non-chemically amplified resist are not necessarily applicable to chemically amplified resists. (FF 12.) Therefore, the level of predictability in the lithography art is low.

Accordingly, because of the breadth of the claims, lack of direction or guidance and working examples provided by Appellants, and the unpredictability of the art, and state of the prior art, Appellants' Specification does not provide enablement for the full scope of photoactive compounds recited in the claims.

Dependent claims 23 and 33, which recite that the photoactive compound comprises a phenyl group, are also not sufficiently enabled because the claims lack the base structure depicted in Figure 4.

CONCLUSION

Appellants have identified error in the Examiner's finding that the Specification does not adequately describe "non-chemically amplified photoresist layer does not include a photo-acid generator (PAG)" as recited in claim 27.

Appellants have identified error in the Examiner's determination that Sun discloses non-chemically amplified photoresists for extreme UV lithography.

Claims 21-35 are subject to a new ground of rejection under 35 U.S.C. § 112, first paragraph.

ORDER

We reverse the Examiner's rejections of claims 21-35 under 35 U.S.C. §§ 112, first paragraph, and 103(a).

This decision contains a new ground of rejection pursuant to 37 C.F.R. § 41.50(b). 37 C.F.R. § 41.50(b) also provides that the Appellants, *WITHIN TWO MONTHS FROM THE DATE OF THE DECISION*, must exercise one of the following two options with respect to the new ground of rejection to avoid termination of the appeal as to the rejected claims:

(1) *Reopen prosecution.* Submit an appropriate amendment of the claims so rejected or new evidence relating to the claims so rejected, or both, and have the matter reconsidered by the Examiner, in which event the proceeding will be remanded to the Examiner . . .

(2) *Request rehearing.* Request that the proceeding be reheard under § 41.52 by the Board upon the same record. . . .

No time period for taking any subsequent action in connection with appeal may be extending under 37 C.F.R. § 1.136(a)(1)(v).

REVERSED

NEW GROUND OF REJECTION (37 C.F.R. §41.50(b))

Appeal 2009-006467
Application 10/687,288

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